Hatchling survival appears to be low in ENP (Mazzotti 1983, Kushlan and Mazzotti 1989), but fairly high in the more sheltered habitats of North Key Largo (20.4 percent)(Moler 1991). Higher survival on Key Largo has been attributed to the close proximity of nest sites to suitable nursery habitat. On the mainland, nest sites on exposed beaches are often far from nursery habitat, requiring recently hatched young to disperse long distances in unsheltered water.

E. Foraging

Compared to the historical estimates of Ogden (1978), populations have declined, and shifts in the nesting distribution have likely occurred. The lowest estimated population levels apparently occurred sometime during the 1960s or 70s when Ogden (1978) estimated the Florida population of the American crocodile to be between 100 and 400 non-hatchlings. Kushlan and Mazzotti (1989) estimated that 220 ± 78 adult and subadult crocodiles remained in South Florida, while Moler believes between 500 and 1,000 individuals (including hatchlings) persist there currently (Moler, pers. comm. 1996).

The American crocodile population is South Florida has increased substantially over the last 20 years, while still remaining well below historic numbers. The recent increase is best represented by changes in nesting effort. Survey data gathered with consistent effort indicates that nesting has increased from about 20 nests in the late 1970's to about 48 nests in 1995. Since it is likely that female crocodiles only produce one clutch per year, it follows that the population of reproductively active females has more than doubled in the last 20 years. In addition, since at least a portion of the population's sex ratio approaches 1:1 (Moler 1991), it is likely that the male portion of the population has also increased substantially.

H. Recovery Plan Objective

Pursuant to the American crocodile Recovery Plan (U.S. Fish and Wildlife Service 1984), to achieve downlisting the following criteria must be met:

- An increase in the number of breeding females to 60. Sixty breeding females translates into an estimated total population size of 1,500 individuals, assuming breeding females comprise 4-5 percent of the total.

Red-cockaded Woodpecker

The red-cockaded woodpecker was federally listed as endangered on October 13, 1970 due to documented declines in local populations, presumed reductions in available nesting habitat, and because of its perceived rarity (35 FR 16047). No critical habitat has been designated for this species.

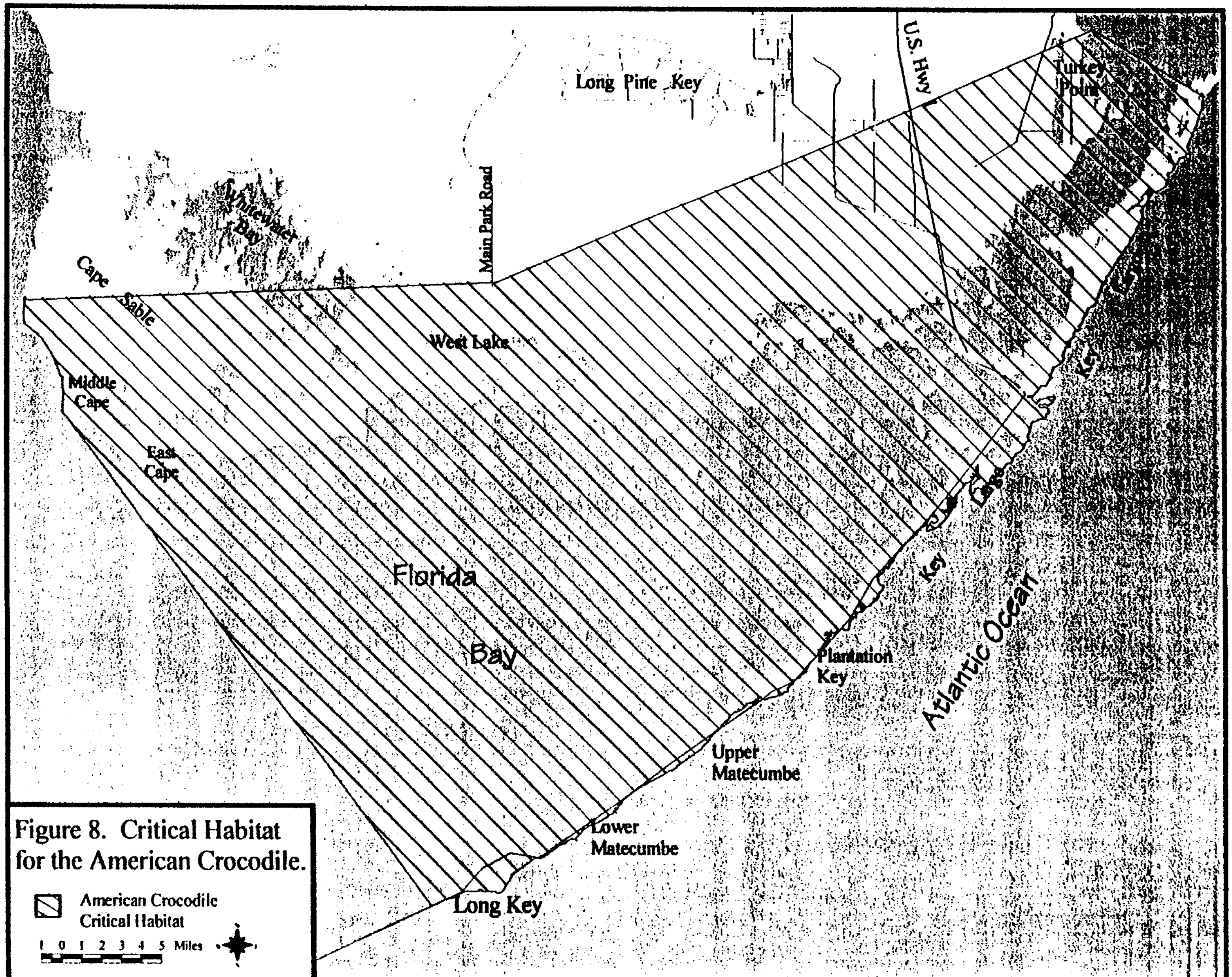

Figure 8. Critical Habitat for the American Crocodile.

A. Distribution

The red-cockaded woodpecker is found in all southern and southeastern coastal States from eastern Texas into southern Virginia, and small populations in the interior are found in southeastern Oklahoma, southern Arkansas, and southeastern Kentucky. The largest populations are in Coastal Plain forests of the Carolinas, Florida, Georgia, Alabama, Mississippi, Louisiana, and eastern Texas, and in the Sandhill forests of the Carolinas (U.S. Fish and Wildlife Service 1985).

The red-cockaded woodpecker probably once occurred in all 67 Florida counties, with exception of the Florida Keys in Monroe County (Hovis and Labisky 1996). The southernmost historic record is from the Florida City area in Dade County (Howell 1921). This species is still widely distributed in the state, but substantial populations now occur only in the panhandle; elsewhere, populations are relatively small and disjunct. The estimated breeding population of the red-cockaded woodpecker in Florida is 1,500 pairs, with about 75 percent of that total occurring in the panhandle (Cox *et al.* 1995).

In South Florida, the status and distribution of the red-cockaded woodpecker is uncertain, particularly in Highlands, Glades, St. Lucie, Martin, and Sarasota counties because of the inability to access and survey private lands that may support suitable habitat.

B. Habitat

Pine stands, or pine-dominated pine/hardwood stands, with a low or sparse understory and ample old-growth pines, constitute primary red-cockaded woodpecker nesting/roosting habitat. The low/sparse understory affords unimpeded access to cavities. Red-cockaded woodpeckers will abandon otherwise suitable nesting/roosting areas when the understory approaches cavity height (Wood 1996).

In south central Florida, at Avon Park Air Force Range, cavities are excavated only in longleaf pine, even though active red-cockaded woodpecker clusters occur in mixed longleaf/slash pine stands (Bowman and Fitzpatrick 1993). South of the longleaf pine range, red-cockaded woodpeckers can only excavate cavities in slash pine. In this region, cavity trees selected by red-cockaded woodpeckers are typically shorter and smaller in diameter-breast-height, on average, than cavity trees elsewhere in the southeast (Shapiro 1983).

Red-cockaded woodpecker clusters are typically found in the older or oldest, sparsely stocked pine stands, where cavity trees are more widely spaced than trees found further north. Shapiro (1983) attributed the differences in cavity trees and vegetation to be due to the poor site quality and growth conditions of South Florida flatwoods, and historic timber management practices.

In southwest Florida (Charlotte, Collier, and Lee counties), the hydric slash pine (*P. elliotii* var. *densa*) flatwoods provide the preferred nesting and foraging habitat for red-cockaded woodpeckers (Beever and Dryden 1992). This community has been maintained by fire and hydroperiod, and therefore does not have the dense midstory more typical of xeric and mesic flatwoods in southwest Florida. Also, hydric pine flatwoods were not as accessible to historic forestry, agriculture, and land clearing practices as the xeric and mesic communities.

Older growth pine or pine-dominated stands are also needed for foraging, but not to the extent needed for nesting/roosting. Red-cockaded woodpeckers will forage to some degree on hardwood trees and even in bayheads and cypress domes, but in general, mature pines constitute the primary foraging substrate. This habitat, in association with or proximal to nesting/roosting habitat, is necessary for population survival. In South Florida, red-cockaded woodpeckers need more habitat for foraging than in areas farther north because of the poor habitat quality (less than 30 square feet/acre pine basal area) (Hovis and Labisky 1996).

C. Reproduction

Red-cockaded woodpeckers attain breeding age at 1 year, however, reproductive success improves with increased age (Walters 1990). The nesting season in Florida is late April through early June. The nest cavity is also unusually the roost cavity of the breeding male (Ligon1970). The red-cockaded woodpecker is monogomous and is essentially single brooded (Jackson 1994). Clutch size is normally 2-4 eggs and incubation is 10-11 days (Ligon 1970). Although not all groups produce young, in south Florida, 81 percent of groups were found to be successful.

D. Foraging

Red-cockaded woodpeckers forage primarily on arthropods, taken by chipping away the outer layer of tree bark and gleaning what they find underneath. They will occasionally feed on vegetative matter such as pine mast and fruits (Jackson 1994). They have also been observed taking flying insects on the wing. Red-cockaded woodpeckers typically forage in larger pines in pine-dominated habitat (90 percent), rather than in hardwoods.

E. Movements

The spatial extent needed to sustain red-cockaded woodpeckers depends primarily on habitat quality. Home ranges in optimal quality habitat in the Carolinas average 170-220 acres In most of Florida, however, habitat quality is considerably lower than the more optimal conditions in the Carolinas, as well as other areas within the species' range. Habitat quality in southern and central Florida is particularly marginal in that respect; home ranges average 346-395 acres , but can exceed 494 acres (Wood 1996). Territory sizes for red-cockaded woodpeckers in South Florida have been reported as large as 741-988 acres in Big Cypress National Preserve, because the pinelands are not contiguous. At Avon Park Air Force Range, the largest home range size reported was 890 acres , with an average of 395 acres . In constrained territories, home range is limited to 173 acres (U.S. Fish and Wildlife Service 1998).

F. Status and Trends

Jackson (1978) estimated the total population of red-cockaded woodpeckers to be between 1,500-3,000 clusters and 4,500-10,500 birds, based upon extensive literature reviews and questionnaire surveys. This was revised from his earlier estimate of 2,939 birds - a conservative estimate based upon limited data.

The most extensive, rangewide population surveys for red-cockaded woodpeckers have been conducted on federal lands. In 1979, the Service's Southeast Region and the USFS initiated a rangewide survey of clusters on federal lands in the southeast. The results of this effort estimated 2,677 (+/- 456) active red-cockaded woodpecker clusters on the lands censused (Lennartz *et al.* 1983). With the addition of a few federal properties not included in the census, the population was subsequently estimated to exceed 3,000 active clusters (Lennartz and Henry 1985). Among the federal lands censused (national forests, military bases, national wildlife refuges), the largest number of active clusters (2,121) was found on national forests. More recent surveys estimate the rangewide population at 4,694 active clusters (Costa and Walker 1995).

Recovery Plan Objective

The establishment of one or more viable populations of red-cockaded woodpeckers in South Florida toward the overall recovery goal for the species throughout its range. This effort should focus on the hydric pine flatwoods community of southwest Florida. This objective will be achieved when a reserve design for South Florida is developed that identifies patches of suitable-sized nesting and foraging habitat (stands of old-age, mature pines of adequate size) essential for preventing further declines in the population; when any further loss and fragmentation of habitat within these reserves has been prevented; when suitable, occupied habitat within the reserves is protected through appropriate management on public and private lands, land acquisition, and cooperative agreements with private landowners, when additional nesting and foraging habitats are created or restored adjacent to existing clusters; when augmentation or artificial starts are successfully implemented where needed to establish new groups; and when groups of red-cockaded woodpeckers within the reserves sustain a rate of population increase equal to or greater than 0.0 as a 3-year running average for at least 10 years.

Bald eagle

The bald eagle was listed as endangered on March 11, 1967 due to significant population declines (32 FR 4001). On July 12, 1995, the bald eagle's status was downgraded from endangered to threatened due to substantial population increases following conservation efforts, including the banning of DDT and other organochlorides (60 FR 36010). No critical habitat has been designated for this species.

A. Distribution

The bald eagle was historically found throughout the North American continent from the Aleutian Islands and western Alaska to the Maritime Provinces of Canada and south to the Florida Keys, the Gulf Coast, and Baja California (Curnutt 1996). Apart from Alaska, most nesting bald eagles were found in Florida, the Chesapeake Bay area, the Great Lakes region, Maine, and the Pacific northwest. In Florida, eagles were historically found throughout the state, although they were probably most abundant along large rivers and lakes. Eagles were probably never numerous in the panhandle or extreme southeastern Florida. Today, bald eagle nesting is prevalent along the southwest coast, the Gulf Coast from Pinellas County north to the Suwannee River, the St. Johns/Oklawaha River basins, and the Kissimmee River valley including Polk and Osceola counties (Curnutt 1996).

B. Habitat

Bald Eagles are considered a water-dependant species typically found near estuaries, large lakes, reservoirs, major rivers and some seacoast habitats (U.S. Fish and Wildlife Service 1998). Their distribution is influenced by the availability of suitable nest and perch sites near large, open water-bodies, typically with high amounts of water-to-land edge.

Nesting habitat includes the nest tree, perch and roost sites, and adjacent high use areas but usually does not include foraging areas. The nest, perch, roost sites, and use areas around the nest, comprise the nesting territory. The size and shape of a defended nesting territory varies greatly depending on the terrain, vegetation, food availability, and eagle density in the area. Generally, bald eagle nesting habitat is adjacent to, or near large bodies of water that are used for foraging (U.S. Fish and Wildlife Service 1998). Nest sites must also provide good visibility, and a clear flight path to the nest (Montana Bald Eagle Working Group 1991).

In Florida, nests are often in the ecotone between forest and marsh or water, and are constructed in dominant or co-dominant living pines (*Pinus* spp.) or bald cypress (*Taxodium distichum*) (McEwan and Hirth 1979). About 10 percent of eagle nests are located in dead pine trees while two to three percent occur in other species such as Australian pine (*Casuarina equisetifolia*) and live oak (*Quercus virginiana*). The stature of nest trees decreases from north to south and in extreme southwest Florida (Wood *et al.* 1989), eagles nest in black (*Avicennia germinans*) and red mangroves (*Rhizophora mangle*), half of which are snags (Curnutt and Robertson 1994). Nest trees in South Florida are smaller and shorter than reported elsewhere, however, eagles nesting here select the largest trees available (Wood *et al.* 1989, Hardesty 1991). The small size of nest trees in South Florida relative to other nest sites throughout its range is due to the naturally smaller stature of *Pinus elliottii*, *P. taeda*, *P. palustris* and *P. clausa* in South Florida.

C. Reproduction

Most breeding eagles construct nests within several hundred yards of open water (U.S. Fish and Wildlife Service 1998). In Florida, most nests were located within two miles of open water, substantially further than other reported distances (McEwan and Hirth 1979, Wood *et al.* 1989).

In the Southeast, nesting activity generally begin in early September, with egg laying occurring as early as late October, and peaking in the latter part of December. Depending on latitude, incubation may be initiated from as early as October to as late as March. Clutches usually consist of one or two eggs, but occasionally three or four are laid. Parental care may extend four to six weeks after fledging even though young eagles are fully developed and may not remain at the nest after fledging.

D. Foraging

The bald eagle is an opportunistic feeder. Accordingly, its diet varies tremendously, depending on the time of year and habitat. Most studies indicate that fish are an important component of the eagle's diet, while birds and mammals account for the bulk of the remaining foods (Johnsgard 1990). During the winter, reduced availability of prey resulting from frozen waters require interior eagle populations to switch from a predominately fish diet to one of birds and mammals. Carrion is taken by many eagles and is also a substantial portion of the diet, especially for coastal eagles dependent on post-spawning salmonids. Some interior populations may also rely heavily on carrion particularly during late winter and early spring.

In the Southeastern United States the bulk of the diet is fish. Broley (1947) found catfish (*Ictalurus* spp.), mullet, and turtles, to be the most common food items found at nests in Florida. He also found that the variety of prey items differ among individual pairs. McEwan (1977) reported 79 percent fish and 17 percent bird prey, by occurrence, based on 788 animal remains recovered from nests. Of these, the dominant items were catfish and the American coot (*Fulica americana*).

E. Movements

Adult birds in coastal Alaska, Canada, the Pacific Northwest, Florida, and the Chesapeake Bay areas do not migrate, although dispersal of young may occur seasonally from some of these areas. Juvenile birds fledged in Florida are highly migratory, with more than one-third of the recoveries made 1,000 miles or more north of Florida, all during the non-nesting season (Broley 1947). Most radio-collared juveniles return each year but a small proportion remain away for two to three years.

Little information is available on the dispersal of bald eagles as they approach and enter early adulthood . If paired, it is assumed these birds remain in Florida as do most other paired adults. If not paired, it is not clear whether these birds continue to migrate north during summer or remain in Florida with the breeding adults. Similarly, it is not known whether all birds fledged in Florida ultimately breed in Florida.

In southern peninsular Florida, bald eagles breed and nest during the temperate winter. Contrary to changes in habitat use exhibited by northern bald eagle populations, eagles in the south do not substantially alter habitat use throughout the year. Some adults may remain in and defend their nesting territory outside of the breeding season (Palmer 1988), use or defend portions of their territory, or disperse and congregate at predictable food sources such as landfills. Of those adults that do not maintain territories throughout the year, most are not thought to leave the state. Conversely, following fledging, many juvenile eagles disperse north and summer from along the Atlantic Coast west to the Appalachian Mountains and north as far as Canada (Broley 1947, Wood and Collopy 1995).

F. Status and Trends

Bald eagle nesting in Florida has been widely studied and published accounts are available from a variety of sources. Broley (1947) was the first to document a decline in eagle nesting in the late 1940s. A further decline from 73 to 43 active nesting areas was reported for west central Florida between 1936 and 1956. Howell (1973) reported a decline in nesting around Merritt Island from 24 nests in 1935 to four nests in 1971. An excellent summary was provided by Peterson and Robertson (1978), in which they characterized the bald eagle population of the 1970s as less than 50 percent of historic numbers and still slowly decreasing.

State natural resource agencies, and conservation organizations initiated surveys for nesting bald eagles in the early 1950s which reveal that bald eagle numbers declined from historic numbers in many locations. A nationwide survey by the Service, State wildlife agencies, and conservation groups in 1974 indicated that eagle numbers and their reproductive success in certain areas were low enough to warrant protective actions.

In Florida, bald eagle nesting and productivity has increased dramatically since the early 1970s. Florida currently supports the highest number of breeding bald eagles of any southeastern state, supporting approximately 70 percent of the occupied territories in this region (Nesbitt 1995). Although numbers and productivity of bald eagles are increasing in Florida, concerns remain about the cumulative impacts associated with continued agricultural, residential, and commercial development (Wood 1987, Nesbitt 1995).

G. Recovery Plan Objective

Efforts have only recently been initiated to develop delisting criteria for bald eagles in the southeast. The objective for South Florida's contribution to the recovery of the bald eagle will be achieved when; at least 45.4 percent of the total of occupied territories throughout the State of Florida are protected in South Florida; these territories are managed or enhanced to increase productivity; average productivity for occupied territories is greater than or equal to 1.13 chicks over a consecutive 10-year period. The percentage of active territories located in South Florida may change if the balance of the state's bald eagle population increases or decreases at a different rate than South Florida. In this case, the objective may be modified to maintain the number of territories found in South Florida in the 1996-97 nesting season.

Eastern indigo snake

The eastern indigo snake was listed as a threatened species on January 31, 1978 due to a serious population decline caused by habitat loss, over-collecting for the pet trade, and mortality from gassing gopher tortoise burrows to collect rattlesnakes (43 FR 4028). No critical habitat has been designated for this species.

A. Distribution

Georgia and Florida currently support the remaining, endemic populations of the eastern indigo snake (Lawler 1977). In 1982, only a few populations remained in the Florida panhandle. In these areas, the species is considered rare. Nevertheless, based on museum specimens and field sightings, the eastern indigo snake still occurs throughout Florida, though not commonly seen (Moler 1985).

B. Habitat

Over most of its range in Florida, the eastern indigo snake frequents diverse habitats such as pine flatwoods, scrubby flatwoods, flood plain edges, sand ridges, dry glades, tropical hammocks, edges of freshwater marshes, muckland fields, coastal dunes, and xeric sandhill communities. On the central Atlantic coast, eastern indigo snakes can be found in orange groves and near ditches and canals. In south Florida, these snakes are found in pine flatwoods and tropical hammocks or in most undeveloped areas (Kuntz 1977); although they may use open areas more than hammocks. Eastern indigo snakes also use agricultural lands and various types of wetlands, with higher population concentrations occurring in the sandhill and pineland regions of northern and central Florida.

Smith (1987) radio-tagged hatchling, yearling, and gravid eastern indigo snakes and released them in different habitat types on St. Marks National Wildlife Refuge in Wakulla County, Florida, in 1985 and 1986. He concluded that diverse habitats, including high pineland, pine-palmetto flatwoods, and permanent open ponds, were important for the eastern indigo snake's seasonal activity. Habitat use differed by age, class, and season. Stumps, ground litter, and saw palmetto debris were frequently used as refugia. Adult indigo snakes often used gopher tortoise burrows (*Gopherus polyphemus*) during April and May, while juveniles chose smaller root and rodent holes.

Eastern indigo snakes need a mosaic of habitats to complete their annual cycle. Interspersion of tortoise-inhabited sandhills and wetlands improves habitat quality for the indigo snakes (Landers and Speake 1980). Wherever the eastern indigo snake occurs in xeric habitats, it is closely associated with the gopher tortoise, the burrows of which shelter the indigo snakes from winter cold and desiccating sandhill environment (Bogert and Cowles, 1947; Speake, *et al.* 1978). This dependence seems especially pronounced in Georgia, Alabama, and the panhandle area of Florida, where eastern indigo snakes are largely restricted to the vicinity of sandhill habitats occupied by gopher tortoises (Diemer and Speake, 1981; Moler 1985; Mount 1975). In wetter habitats that lack gopher tortoises, eastern indigo snakes may take shelter in hollowed root channels, hollow logs, or the burrows of rodents, armadillo, or crabs (Lawler 1977, Moler 1985). In south Florida, indigo snakes occur along canal banks, where they use crab holes in lieu of gopher tortoise burrows (Lawler 1977).

C. Reproduction

Eastern indigo snakes breed between November and April, with females depositing 4-12 eggs during May or June (Moler 1992). Young hatch in approximately 3 months from late May through August with peak hatching activity occurring between August and September, while yearling activity peaks in April and May (Smith 1987). There is no evidence of parental care although the snakes take 3 to 4 years to reach sexual maturity (Moulis 1976).

D. Foraging

The eastern indigo snake is a generalized predator and will eat any vertebrate small enough to be overpowered. The snake's food items include fish, frogs, toads, snakes (venomous as well as nonvenomous), lizards, turtles, turtle eggs, small alligators, birds, and small mammals.

E. Movements

Outside of peninsular Florida, eastern indigo snakes are generally restricted to the vicinity of xeric habitats that support populations of gopher tortoises, although they move seasonally into more mesic habitats. Throughout peninsular Florida, the eastern indigo snake may be found in all terrestrial habitats which have not suffered high density urban development. They are especially common in the hydric hammocks of north Florida and in similar habitats throughout peninsular Florida (Moler 1985).

F. Status and Trends

The wide distribution and large territory size of the eastern indigo snake complicate evaluation of its population status and trends. Although we have no quantitative data with which to evaluate the trend of eastern indigo snakes in South Florida, we surmise the population as a whole is declining because of current rates of habitat destruction and degradation. Fragmented habitat patches probably cannot support a sufficient number of indigo snakes to ensure viable populations.

G. Recovery Plan Objective

The objective is to stabilize and increase numbers of indigo snakes in South Florida. An increasing population will need to sustain a rate of increase greater than 0.0 as a 3-year running average over at least 10 years. Once it is determined that sufficient, suitable habitat exists in South Florida for the eastern indigo snake population to stabilize or increase, delisting criteria can be considered. The development of delisting criteria will require the analysis of demographic data to demonstrate that there are adequate, contiguous tracts of upland habitat in South Florida to ensure at least a 95 percent probability of persistence for the eastern indigo snake for 100 years.

Garber's spurge

The Garber's spurge was listed as a threatened species on July 18, 1985 (50 FR 29349) due to the destruction and degradation of its habitat: pine rocklands, coastal flats, coastal grasslands, beach berms, and beach ridges. No critical habitat has been designated for this species.

A. Distribution

The Garber's spurge is an endemic of Florida that occurs on less than five locations from Perrine in Dade County, west to Cape Sable, and south to most of the Keys in Monroe County (Small 1903, 1933). While most populations of the Garber's spurge occur in coastal habitats, one population in Dade County is approximately 16 miles inland from Florida Bay.

B. Habitat

Garber's spurge grows at low elevations (<10 feet) in well- to poorly-drained, calcareous sands or directly on exposed limestone in a variety of open to moderately-shaded vegetative communities. In pine rocklands, Garber's spurge grows in crevices in oolitic limestone. On Cape Sable in Everglades National Park, Garber's spurge has been reported from hammock edges, open grassy prairie, and backdune swales. In the Keys, Garber's spurge grows on semi-exposed limestone shores, open calcareous salt flats, pine rocklands, calcareous sands of beach ridges, and along disturbed roadsides.

The Garber's spurge occurs in vegetative communities that historically are naturally prone to periodic disturbance. Pine rocklands and coastal grasslands experience frequent wildfires, while coastal habitats are prone to periodic submergence at high tide or during storm surges.

C. Reproduction

The Garber's spurge is a perennial that reproduces sexually by seed. Reproductive ecology in *Chamaesyce* has been poorly studied but it is known to be highly variable (Ehrenfeld 1976, 1979; Webster 1967). Some spurges are completely reliant on insects for pollination and seed production while others are self-pollinating. Pollinators may include bees, flies, ants, and wasps (Ehrenfeld 1979). Seed capsules of many Euphorbiaceae are explosively dehiscent, ejecting seeds a short distance from the parent plant. The seeds of some species are dispersed by ants (Pemberton 1988).

D. Status and Trends

The total population of the spurge has been estimated as less than 1,000 individual plants. A status survey by Austin *et al.* (1981) found five sites; three on Cape Sable (ENP), one on Long Pine Key (ENP), and one on Big Pine Key. Only the Long Pine Key site has been resurveyed, and it was found to contain approximately 150 plants. The status of the three Garber's spurge populations on the Cape is not known. A new population was found in 1988 at the Charles Deering Estate, Dade County, after a burn. It had 250 plants in 1991 but the population size appears to be getting smaller. Two other sites, located at Bahia Honda State Park and Long Key State Recreation Area, have populations and trends which are unknown. The remaining habitat is relatively fragmented and most populations are disjunct and small, causing concerns that these populations are more susceptible to extirpation from a single natural or manmade disturbance.

E. Recovery Plan Objective

The recovery objective is to stabilize existing populations within the historic range of the species and protect these sites from further habitat loss, degradation, exotic plant invasion, and fire suppression. Once the existing populations are stabilized, delisting may be considered when enough demographic data are available to determine the appropriate numbers of self-sustaining populations required to assure 95 percent probability of persistence for 100 years; when these populations within the historic range are adequately protected from further habitat loss, degradation, exotic plant invasion, and fire suppression; when these sites are managed to maintain the pine rocklands to support the species; and when monitoring programs demonstrate that populations on these sites support sufficient population sizes, are distributed throughout the historic range, and are sexually or vegetatively reproducing at sufficient rates to maintain the population. The recovery objective will be reassessed annually based on new research.

Analysis of the species/critical habitat likely to be affected

1. Cape Sable seaside sparrow - the **Experimental Program** would adversely affect the sparrow due to the timing, volume, and direction of regulated water releases resulting in adverse nesting habitat alteration and sparrow population declines. In addition, hatchlings or eggs would be vulnerable to direct crushing by heavy equipment during construction activities.

The **Modified Water Deliveries** project will provide for water deliveries that mimic more natural water flow conditions across the sparrow's nesting habitat. The Service anticipates these conditions will provide for the frequency of nesting opportunities and maintenance of nesting habitat necessary for the sparrow's long-term viability. Further, no adverse effects are anticipated due to construction because these activities will not occur in or near sparrow habitat.

Consequently, the Service anticipates the **Modified Water Deliveries** project is not likely to adversely effect the Cape Sable seaside sparrow.

The **C-111 Project** would increase wet season water flows to the Rocky Glades and Taylor Slough areas, improving hydroperiods in marl prairie habitats in this area, which should maintain suitable nesting substrate and enhance nesting opportunities. Thus, the hydrological effects of the **C-111 Project** are not likely to adversely effect the Cape Sable seaside sparrow. Construction related activities associated with the **C-111 Project** could disturb birds during the breeding season, therefore, these activities are anticipated to result in adverse effects to the sparrow.

2. West Indian Manatee - The **C-111 Project** would improve the timing and volume of freshwater flows to Florida Bay estuaries (NPS 1993). The **Experimental Program** provides greater volumes of freshwater flow into Florida Bay in all months (Van Lent et al. 1999). Since manatees prefer habitats that include sources of freshwater, these projects may increase the area of habitat suitable for manatees in Florida Bay. Decreased salinities and decreased temperatures associated with increased freshwater inflows may cause a shift in seagrass species composition. However, manatees eat all species of seagrasses and are not thought to be food limited in this area (U.S. Fish and Wildlife Service 1998). Further, no adverse effects are anticipated due to construction because these activities will not occur in or near manatee habitat. Consequently, implementation of the **Experimental Program** and the **C-111 Project** are not likely to adversely affect the West Indian manatee.

The **Modified Water Deliveries** project would result in substantially decreased freshwater inflows to Florida Bay resulting in a higher percentage of months with high salinities and increased temperatures in this area (Van Lent et al. 1999). Prior decreases in freshwater flows associated with the original C&SF project probably increased salinities in this area above manatee tolerance levels, rendering much of the area unsuitable. In addition, much of Florida Bay is too shallow to provide suitable manatee habitat causing manatees to avoid this area. Therefore, an additional decrease in freshwater flows is not likely to adversely affect the West Indian manatee or its critical habitat. Further, no adverse effects are anticipated due to construction because these activities will not occur in or near manatee habitat.

3. Florida Panther -The Florida panther is not likely to be adversely affected by implementation of these proposed actions because the preferred upland habitats of this species will not be impacted by either construction activities or manipulation of hydrologic conditions.

4. Snail Kite - No known snail kite nesting habitat occurs in areas affected by the **C-111 Project** (Bennetts *et al.* 1994, Bennetts and Kitchens 1997). Therefore, the **C-111 Project** will not adversely affect the snail kite or its critical habitat.

The **Experimental Program** and the **Modified Water Deliveries** project will maintain deep impounded pools in WCA-3A that degrade nesting habitat due to the loss of woody vegetation and foraging habitat due to the loss of wet prairie communities. Therefore, the **Experimental Program** and the **Modified Water Deliveries** project are likely to adversely affect the snail kite. Due to the Corps' adoption of a Construction Monitoring Plan, construction related activities associated with these two projects are not likely to adversely effect the snail kite.

5. Wood Stork - The **C-111 Project** would increase wet season water flows to the Rocky Glades and Taylor Slough areas, improving hydroperiods in marl prairie habitats in this area, and improving the timing and volume of freshwater flows to Florida Bay estuaries (Van Lent et al. 1999). This should improve availability and timing of food resources important to nesting wood storks (Ogden 1994, U.S. Fish and Wildlife Service 1998). Further, no adverse effects are anticipated due to construction because these activities will not occur in or near wood stork habitat. Consequently, implementation of the **C-111 Project** is not likely to adversely effect the wood stork.

The **Experimental Program** would continue the current reduced duration and timing of hydroperiods and flow volumes in two areas of Shark River Slough and the volume and timing of water passing through southern portions of Shark River Slough and Taylor Slough as compared to historic conditions, and the **Modified Water Deliveries** project would result in a further decrease in the duration and timing of hydroperiods in two areas of Shark River Slough and the volume and timing of water passing through southern portions of Shark River Slough and Taylor Slough as compared to the **Experimental Program**. Both proposed actions would effect the amount and timing of freshwater reaching the mangrove zone nesting habitat. These reductions are of sufficient magnitude to delay colony formation and ultimately increase the probability of an unsuccessful nesting season. Therefore, the Service anticipates that the **Experimental Program** and the **Modified Water Deliveries** project are likely to adversely effect the wood stork. Due to the Corps' adoption of a Construction Monitoring Plan, construction related activities associated with these two projects are not likely to adversely effect the wood stork.

6. American Crocodile - The **C-111 Project** would improve the timing and volume of freshwater flows to Florida Bay estuaries (NPS 1993) and the **Experimental Program** would continue current freshwater flows. Changes in the hydrologic flow that mimic natural flow conditions are likely to benefit crocodiles, in addition, continued current conditions will not affect crocodiles. No adverse effects are anticipated due to construction because these activities will not occur in or near American crocodile habitat. Consequently, implementation of the **Experimental Program** and **C-111 Projects** are not likely to adversely effect the American crocodile.

The **Modified Water Deliveries** project is anticipated to result in reduced volume flows into Florida Bay estuaries than would occur under current conditions. This would result in increased salinity levels that would result in lower survival rates of hatchling crocodiles and reduced reproductive potential for adults. Consequently, the Service anticipates the **Modified Water Deliveries** project is likely to adversely effect the crocodile. Further, no adverse effects are anticipated due to construction because these activities will not occur in or near American crocodile habitat.

7. Red-cockaded Woodpecker -The red-cockaded woodpecker is not likely to be adversely affected by implementation of these proposed actions because the preferred upland habitats of this species will not be impacted by either structural construction activities or manipulation of hydrologic conditions.

8. Bald Eagle - The bald eagle is not likely to be adversely affected because the proposed actions will not impact any bald eagle nesting sites, will not substantially reduce the spatial extent of the natural habitat types utilized by bald eagles for foraging and resting, and the Service anticipates that individual bald eagles will adjust to expected gradual shifts in the location or composition of natural habitats, resulting in insignificant effects.

9. Eastern Indigo Snake -The Eastern indigo snake is not likely to be adversely affected by hydrological changes resulting from the proposed actions because the proposed actions will not substantially reduce the spatial extent of the natural habitat types utilized by the Eastern indigo snake and the Service anticipates that individual snakes will adjust to expected gradual shifts in the location or composition of natural habitats, resulting in insignificant effects. Since the Corps has agreed to incorporate a Construction Monitoring Plan for the Eastern indigo snake that will ensure that no snakes are injured or killed during construction activities, the Service has determined that construction activities associated with these proposed actions will not adversely affect the Eastern indigo snake.

10. Garber's Spurge -The Garber's spurge is not likely to be adversely affected by implementation of these proposed actions because the preferred upland and coastal habitats of this species will not be impacted by either construction activities or manipulation of hydrologic conditions.

ENVIRONMENTAL BASELINE

This section is an analysis of the effects of past and ongoing human and natural factors leading to the current status of the species, their habitats (including designated critical habitat), and ecosystems within the action area. The environmental baseline is a "snapshot" of a species' health at a specified point in time. It does not include the effects of the actions under review in the consultation. Rather, the effects analyzed in this biological opinion will be additive to establish a new environmental baseline.

Since, between them, the **Modified Water Deliveries** project and the **Experimental Program** have had three previous biological opinions issued within the action area (February 1990, June 1993, October 1995), the environmental baseline for the current proposed actions will be the one established by the issuance of the October, 1995, biological opinion on Test 7 (Phase I) of the **Experimental Program.**

The October 1995 biological opinion determined that Test Iteration 7 would jeopardize the sparrow unless: (1) Water flows through the S-12 structures should be distributed in a manner that restores and maintains the short hydroperiods of the marl prairies and sloughs west of Shark River Slough, to the maximum extent possible within the operating constraints of Test 7; (2) during the nesting period of the Cape Sable seaside sparrow (January through June) pumping at S-332 should be limited to 165 cfs, to the maximum extent possible; (3) the Corps, with the cooperation of the Service, NPS, SFWMD, and GFC, should undertake a comprehensive monitoring and research program on the Cape Sable seaside sparrow within the action area; (4) the Corps, with the cooperation of the Service, NPS, SFWMD, and the GFC, should develop a plan that identified remedial actions and management interventions that could be taken if the status of the Cape Sable seaside sparrow population declines during Test 7; and, (5) the Corps, in cooperation with the SFWMD, the NPS, and the Service, should examine future options to restore the everglades ecosystem to identify ways to redistribute regulatory releases from WCA 3A more naturally over as large a geographic area as possible.

The effects of the current proposed actions under consultation, along with cumulative effects, will be added to the environmental baseline to determine if implementation will jeopardize the continued existence of the Cape Sable seaside sparrow, snail kite, wood stork or American crocodile.

Status of the species within the action area

Cape Sable Seaside Sparrow

Presently, the known distribution of the Cape Sable seaside sparrow is restricted to localized areas on the east and west sides of Shark River Slough which is entirely contained within the action area. Therefore, pertinent habitat and life history information utilized in the analysis of past and ongoing factors leading to the current status of the species and its habitat within the action area is provided in the *Status of the species/critical habitat* section of this document. The status of the Cape Sable seaside sparrow after the breeding season in 1995 is provided below.

By 1995, subpopulation A, located in the western marl prairies and representing approximately 50 percent of the total population in 1992, had disappeared from all but a few locations. It was noted in the Service's October, 1995, biological opinion on Test 7 of the **Experimental Program**, that the Cape Sable seaside sparrow was now represented by a single viable subpopulation (subpopulation B) and two subpopulations (subpopulations A and C-F) too small to persist over the long term. Subpopulation A increased slightly to 272 birds in 1996 and 1997, and declined again in 1998 to 192 birds.

The smaller subpopulations located in the eastern marl prairies are struggling to persist. For example, subpopulations C, D, and F appear to have been extirpated in 1995, but the 1996 and 1997 surveys located a small number of birds at each of these sites. The 1998 survey results in subpopulations C, D, and F estimated 80, 48, and 16 birds, respectively, or approximately 5 percent of the total 1998 rangewide estimate. The 1995 estimate for subpopulation B, considered the most stable of all the sparrow subpopulations, was 2,128 birds. This subpopulation declined to 1,888 birds in 1996, increased to 2,832 in 1997, and declined again in 1998 to 1,808 birds. Subpopulation E, the remaining eastern prairie subpopulation, had a 1995 estimate of 352 birds, declined in 1996 to 208, increased in 1997 to 832, and again increased in 1998 to 912.

Snail Kite

Snail kite use of the action area fluctuates greatly, with low use during drought years, such as 1991, and high use in wet years, such as 1994. Although sharp declines have occurred in the counts since 1969 (for example, 1981, 1985, 1987), it is unknown whether decreases in snail kite numbers in the annual count are due to mortality, dispersal (into areas not counted), decreased productivity, or a combination of these factors. Despite these problems in interpreting the annual counts, the data since 1969 have indicated a generally increasing trend (Bennetts *et al.* 1994). The annual counts since 1995 confirm a continued increasing trend, however, the degree of this apparent increase in the snail kite's population needs to be confirmed with alternative methods of estimating population size.

Wood Stork

Historically, South Florida supported greater than 70 percent of the total nesting effort in the southeast U.S. In 1996, nesting effort in South Florida improved from the previous three years, most likely in response to improved foraging conditions as a result of a rapid dry-down following three high water years. In Everglades NP, Big Cypress National Preserve, Corkscew National Sanctuary, and Florida Panther NWR, there were a total of approximately 1,600 nesting pairs. Numbers of nesting storks in the action area have declined since 1996, averaging about 142 nesting pairs (Ogden 1998, personal communication).

American Crocodile

Kushlan and Mazzotti (1989) estimated that 220 ± 78 adult and subadult crocodiles remained in South Florida, while Moler believes between 500 and 1,000 individuals (including hatchlings) persist there currently (Moler, personal communication 1998). The recent increase is best represented by changes in nesting effort. Survey data gathered with consistent effort indicates that nesting has increased from about 20 nests in the late 1970's to about 48 nests in 1995. Since it is likely that female crocodiles only produce one clutch per year it follows that the population of reproductively active females has more than doubled in the last 20 years.

Factors affecting species environment within the action area

This section addresses all unrelated Federal, State, local, Tribal and private actions, within the action area, that will occur contemporaneously with the proposed actions and will affect the species' environment. The Service is aware of only one additional action that will affect the species environment:

> ENP will continue fire management and exotic species control programs within park boundaries that are expected to improve and maintain habitat for the snail kite, wood stork, American crocodile and Cape Sable seaside sparrow.

EFFECTS OF THE ACTION

Effects of each of the proposed actions addressed in this biological opinion will be discussed separately here. Within each discussion, possible effects have been divided into two categories - hydrological effects and construction effects. Hydrological effects are those caused by changes in the timing, volume and direction of water flows resulting from operational changes in the water management system. Construction effects are those caused by construction activities necessary to install new structures or modify existing structures.

Experimental Program

The proposed action, continued operation of Test 7, Phase I, and proposed operation of Test 7, Phase II, of the **Experimental Program**, continues water delivery schedules to Shark River Slough as in Test 7, Phase I, and continues and expands water deliveries to Taylor Slough. Differences between Test 7, Phase I, and Test 7, Phase II, have to do with higher canal stages and increased pumping in the area of the headwaters of Taylor Slough in an effort to increase water levels in the marl prairie areas forming the headwaters of Taylor Slough, increase water deliveries to Taylor Slough, and provide flood control. The **Experimental Program** is likely to adversely effect the Cape Sable seaside sparrow, snail kite, and wood stork.

A. Hydrological Effects

Cape Sable Seaside Sparrow

To assist in determining the effects of the **Experimental Program** on the Cape Sable seaside sparrow, the Service requested the following information from the Corps: (1) hydrologic modeling output for operation of the newly constructed S-332D pump station. The modeling output was requested to provide expected hydropatterns, including flow distributions, depths, and duration of inundation within the breeding habitats of the sparrow; (2) the results of any hydrologic and ecological monitoring completed for Test Iterations 1 through 6; and, (3) weekly records of discharges to Shark River Slough from 1983 to present, distinguishing between quantities delivered to western and northeast Shark River Slough, including quantities derived from the rainfall formula, from supplemental discharges associated with WCA 3A's stage, and quantities associated with the target discharges. Additionally, the Service requested technical assistance from the staff at ENP to also provide similar hydrologic modeling runs for the current Test 7, Phase I, and the proposed Test 7, Phase II. To date, the Corps has provided most of the requested information (except modeling results for S-332D operations) and ENP provided a report focused on the hydrologic aspects of **Modified Water Deliveries**, the **C-111 Project**, and the **Experimental Program** with accompanying computer simulations and discussion of the effects to listed species (Van Lent et al. 1999).

As proposed, the Test 7, Phase II, operational schedule for water release into Shark River Slough is consistent with previous test iterations dating back to 1985, starting with Tests 1- 5, continuing in 1994 with Test 6, and followed by Test 7, Phase I, in 1995. Like the previous test iterations, the concern with Test 7 is the impact of managed water releases through the S-12 spillways into the western marl prairies and it's potential effect on the breeding habitat and behavior of the Cape Sable seaside sparrow within core subpopulation A. Precipitation in combination with managed water releases through the S-12 spillways determine the extent water levels affect the birds directly, by flooding their nests, and indirectly by altering the nesting habitat on which they depend. The amount of water released through the S-12s that will preclude nesting is correlated to: (a) the existing water table level prior to the nesting season and (b) the amount of breeding season rainfall that occurs. There is no consideration in the operational water delivery schedule to sparrow nesting habitat conditions below the S-12s prior to regulated water release. Therefore, the proposed water delivery schedule is anticipated to result in continued adverse effects to the Cape Sable seaside sparrow in subpopulation A during those years when managed water releases will: (1) flood the marl prairies of western Shark River Slough during the sparrow nesting season, whereby unsuitable nesting habitat conditions would be created that effectively preclude successful reproduction (Nott *et al.* 1998); and/or (2) by flooding occupied nesting habitat that results in mortality of eggs or chicks, due to nest flooding, or increased predation (Nott *et al.* 1998). The rationale for these determinations is provided below.

As noted earlier, the sparrow nesting season typically begins as early as mid-March and ends with the onset of the wet season, which can be as late as August. For modeling purposes, the beginning of the sparrow nesting season has been defined as March 15, and the beginning of the wet season has been defined as July 1. The sparrow will not commence nesting activity if water levels over the nesting habitat have not receded below 10 cm, and needs a minimum of 40 consecutive days to complete one breeding cycle; they will successfully fledge two clutches if provided at least an 80 day nesting period (Nott *et al.* 1998). Therefore, one important hydrologic measure for potential sparrow nesting success is to determine the number of consecutive days between March 1 and July 15 that water levels are below 10 cm within nesting habitat. In applying this principle to modeling output that shows the water level at a fixed point such as NP205, it is important to note that, due to the topographic variation within the sparrow's habitat, habitat at a higher elevation than the reference point will remain dry for longer than habitat at or below the reference point elevation. Therefore, for example, a water management scenario that would provide water levels at or below a particular reference point for 60 consecutive days would actually provide the 80 dry days required for completion of two successive broods over much of the habitat at a higher elevation.

The inference from the model simulations provided by Van Lent et al. (1999) is that approximately 60 percent of the time one can expect water levels to be below 10 cm for at least 40 consecutive days during the nesting season. Viewed another way, in 6 out of every 10 years we can expect the water level to be adequate for the sparrow to complete one breeding cycle. Furthermore, the modeling results indicate the sparrow could complete two broods in only 5 out of every 10 years. In determining what effect this has to the sparrow, it is necessary to consider if such a breeding frequency is outside of natural variability.

Reviewing hydrologic conditions during the 20 year period from 1977 through 1996, Nott *et al.* (1998) collected data at a hydrological monitoring index station (NP205) that was considered by the authors as representative of the sparrow's western marl prairie nesting habitat. They also collected data from a rainfall monitoring station close to the S-12A spillway along with daily water release data for the S-12 structures. These data reflect that over the 20 year period, there were 9 years with an insufficient number of dry days during the breeding season for the sparrow to complete one brood. During these 9 years, water was released though the S-12A spillway and the flow ranged from 213 to 2,063 cm/acre/day. There were only two exceptions: (1) In 1980 when there was no regulatory water release through S-12A, however over 15 cm of rainfall fell during the breeding season and only 42 percent of the habitat was available to complete one brood; and, (2) In 1996 when there was no regulatory water release through S-12A, however 13 cm of rainfall fell during the breeding season and only 33 percent of the habitat was available to complete one brood. There were only 4 years over this 20 year period with higher rainfall during the breeding season than occurred in 1996. Conversely, during the 11 years that at least 40 dry days were available during the breeding season for the sparrow to complete one brood, regulatory water releases through the S-12A spillway only occurred in 4 of those years, and the range of water release was relatively low (0.59 to 55.16 cm/acre/day). During these 4 years, mean breeding season water level ranged from 7.15 to 61.77 cm below mean sea level and in 3 of the 4 years the habitat available to complete one brood was above 93 percent; the exception was in 1988, where, due to high breeding season rainfall (over 6 inches), only 63 percent of the habitat was available to complete one brood. It is clear that both local rainfall and discharges from the S-12s impact the water levels at NP205.

The Van Lent et al. (1999) model predicts that if conditions remained the same, 12 out of every 20 years the water level should be adequate to complete one brood. The data set of actual, observed conditions analyzed from Nott *et al.* (1998) reflects that, indeed, in 11 of the past 20 years the nesting habitat conditions were adequate for the sparrow to complete one brood. However, regulatory water releases only occurred during 4 of those years and the actual releases had a relatively low volume flowing through the S-12A spillway (mean of 22 cm/acre/day). During the 9 years when the nesting habitat conditions were inadequate for the sparrow to successfully complete one brood, water releases through the S-12A spillway were considerably larger (mean of 1,040 cm/acre/day). Our conclusion is consistent with the observation of Van Lent and Pimm (1998), that the opening of the S-12 spillways is the single most important factor in predicting nesting success. Continued high flows across the S-12s in combination with a high water table across the nesting habitat and high breeding season rainfall expected under natural rainfall patterns would likely lead to the loss of the western population as a core area.

The loss of one core population breeding season is detrimental, but the loss of consecutive nesting seasons for the Cape Sable seaside sparrow could be critical for its long-term survival. Initiated in 1995, Test 7 is to run for four years. As concluded by Nott *et al.* (1998), the relatively high water levels in 1994-96 kept subpopulation A suppressed; one of only two remaining core populations for the sparrow. Nott *et al.* (1998) noted that since the annual survival of territory-holding males is about 50 percent, four years without breeding would have left few individuals that lived long enough to see the relatively dry year of 1997. Subpopulation A has now remained suppressed for the past 4 consecutive years due to the flooding of their nesting habitat during the breeding season. Furthermore, both Nott *et al.* (1998) and Curnutt *et al.* (1998) document the long-term potential adverse effects of sustained long hydroperiods on the vegetative composition of Cape Sable seaside sparrow nesting habitat.

The sparrow occupies marl prairies dominated by muhly grass or mixed prairies with plant characteristics of short hydroperiods, avoiding longer hydroperiod vegetative communities where plants such as sawgrass (*Cladium jamaicense*) are the dominant species. In both the eastern and western marl prairies, increased water levels similarly changed the vegetation from muhly to sawgrass dominated and so caused the sparrow population to decline (Nott *et al.* 1998). Moreover, with fewer places available to construct nests, vegetational changes have consequences much greater to the sparrow than ephemeral flooding. Sustained hydroperiods across the western marl prairies would alter vegetational composition such that it would eliminate suitable nesting substrate. Without available nesting habitat across the western marl prairies, the loss of subpopulation A would be eminent.

Since the environmental baseline conditions of 1995, when subpopulation A totaled 224 birds, the numbers increased to 416 birds in 1996, this increase was likely the result of the minimal regulatory water releases through the S-12s, but then declined to 272 birds in 1997 and 192 birds in 1998. By 1997 the number of individuals in this core area had dropped to less than 10 percent of its highest recorded numbers since surveys were initiated in 1992. In a risk assessment analysis conducted by Pimm (1997), his simulation modeling determined that if current conditions persist the western population of the sparrow will be lost within 10 years. Van Lent and Pimm (1998) note that another unsuccessful nesting season, the fifth in six years, could result in the loss of subpopulation A, which in turn would lead to a high risk of extinction for the Cape Sable seaside sparrow.

Test 7, Phase I, is anticipated to result in continued decline in the eastern Cape Sable seaside sparrow subpopulations and further deteriorate suitable nesting habitat conditions. This decline is related to over-drainage and the resultant shift in the vegetative community, which increases the frequency of fire such that it becomes detrimental for sparrow breeding (Pimm 1997). Nott *et al.* (1998) and Curnutt *et al.* (1998) attribute declines to over-drainage and resultant fire frequencies in the areas of subpopulations E and F and almost all of subpopulation C located upstream of S-

332, along with flooding that eliminates suitable nesting substrate in the southern part of subpopulation C, located immediately downstream of S-332. These vegetative changes, in turn, are directly related to the hydroperiod, or number of days per year a marsh is flooded (Van Lent et al. 1999). Therefore, another important hydrologic measure to determine the effects of the **Experimental Program** on the Cape Sable seaside sparrow is the hydrologic regime required to maintain the eastern wet prairie habitat.

The proposed Test 7, Phase II, operational schedule for water deliveries to Taylor Slough is predicted to result in slight increases in water levels in the eastern marl prairies compared to the 1995 environmental baseline condition (Van Lent et al. 1999, Corps 1995). Water management operations proposed in Test 7, Phase II, include higher L-31N canal stages and provisions for increased wet season water deliveries to Taylor Slough as compared to those in Test 7, Phase I. Specifically, model runs predict slightly higher water levels in the areas occupied by subpopulations C, E and F and slightly lower water levels in the area of subpopulation D (Van Lent et al. 1999). The Service expects this may result in slight reductions in expected fire frequencies in the areas of subpopulations C, E, and F, which may slightly reduce the extent and duration of unsuitable habitat conditions for sparrows due to frequent fires.

Test 7, Phase I, continues diverting water to the west creating more xeric habitat conditions in the area of subpopulation E, which likely contributed to its decline from 352 birds in 1995 to 192 in 1996. However, subpopulation E has shown an increase to 752 in 1997 and 912 in 1998. This positive trend is anticipated to continue with implementation of Test 7, Phase II, as the projected higher water levels across this area approach conditions that resemble more natural water flow conditions that existed prior to the **Experimental Program** (Van Lent et al. 1999). These slightly higher water levels should restore a more mesic prairie habitat condition that is conducive for sparrow nesting. Such conditions should benefit the sparrow by increasing the potential to produce more young. With an increased probability of establishing nesting territories, sparrow numbers are anticipated to increase slightly in this area

Declines in subpopulations C and F are thought to be the result of over-drainage, which created drier conditions resulting in woody shrub invasion into prairie nesting habitats followed by frequent burns (Curnutt *et al.* 1998). In their analysis of historic fire patterns in ENP from 1982 to 1996, Curnutt *et al.* (1998) determined that longer intervals between fires increase sparrow numbers, for at least 10 years, and that infrequent fires may be necessary to maintain suitable sparrow habitat by removing dense prairie debris and the undesirable woody shrub component. Furthermore, observations of vegetative changes near the existing S-332 pump station (Armentano *et al.* 1995) suggest that pumping at S-332D, and/or continued pumping at S-332, would result in further vegetation shifts from *Muhlenbergia* dominated communities preferred by sparrows to undesirable sawgrass dominated communities in the immediate vicinity of these pumps (part of subpopulation C). Unsuitable habitat conditions further eliminate nesting opportunities and would limit the reproductive potential of subpopulations C and F. After the apparent local extinction by 1995, subpopulation C increased to an estimated 48 birds in 1996 and 1997 and to 80 birds by 1998, while the estimate for subpopulation F has remained at 16 birds since 1996. As of this writing, the Corps has not made a decision on detailed operational criteria for S-332D and S-332, and highly detailed modeling results describing the hydrological effects of the operational options now under consideration are not available. Available results from the Van Lent et al. (1999) modeling give only a general indication of expected water level changes in this area. A precise description of the nature and extent of vegetation shifts resulting from S-332D and/or S-332 operations and, therefore, the precise effects such shifts may have on the Cape Sable seaside sparrow remain speculative.

Unlike the western marl prairies, the concern with subpopulations C and F is not the flooding of nesting habitat, but the diversion of natural water flow to the west, causing drier habitat conditions, invasion of woody shrubs, and frequent fires that preclude the birds from successfully reproducing. Although water levels in the northeastern portion of the sparrow's range, occupied by subpopulations C and F, will increase slightly from the 1995 environmental baseline condition (Van Lent et al. 1999), this slight increase is not anticipated to appreciably reduce fire frequencies or cause a vegetational shift to a more muhly grass or mixed prairie vegetative community preferred by the sparrow for nesting. Such a vegetation shift is necessary to re-establish the eastern core population and reduce the potential for extirpation from a single catastrophic event.

In recent years, subpopulation D experienced an increase in hydroperiod during the nesting season, with resultant decrease in available nesting days, as a consequence of increased water conveyed south through C-111 during Test 7, Phase I (Van Lent et al. 1999). These effects occurred coincident with, and were almost certainly caused by the original dredging of the L-31N canal and subsequent flood control operations of Test 7 Phase I that held stages in L-31N and L-31W low enough to cause drainage of water from the areas of subpopulations E and F and part of subpopulation C (Kushlan *et al.* 1982, Nott *et al.* 1998). The subsequent increased pumping at S-332 resulted in higher water levels and a longer hydroperiod in a part of subpopulation C and subpopulation D located downstream. Consequently, subpopulation D was considered extirpated by 1995, rebounded to an estimated 80 birds in 1996, but declined to only 48 birds in 1997 and 1998. Implementation of Test 7, Phase II, will result in slightly lower water levels across the downstream area of subpopulation D, possibly increasing available nesting days, resulting in beneficial effects by increasing the potential to produce more young. With an increased probability of multiple broods, sparrow numbers are anticipated to increase slightly in this area.

In the area of subpopulation B, in the central portion of the sparrow's range, the proposed operational schedule for the **Experimental Program** is not predicted to result in any significant change to the hydroperiod compared to the 1995 environmental baseline condition (Van Lent et al. 1999). This area is far enough away from the water control features that it remains unaffected by the operational water delivery schedule (Van Lent et al. 1999). Subpopulation B had an estimated 2,048 birds in 1995 and 1996, and increased to 2,784 birds in 1997, but decreased to 1,792 birds in 1998.

Although Test 7, Phase II will slightly increase water levels in subpopulations C and F, these increases will not be sufficient to substantially improve hydroperiods (Van Lent et al. 1999). Therefore, implementation of Test 7, Phase II, like Phase I, will continue to adversely modify designated critical habitat occurring in the areas of subpopulations C and F by facilitating shortened hydroperiods that result in the invasion of undesirable woody shrubs and increased fire frequencies and a change in the vegetative community from muhly grass to sawgrass dominance. Part of the critical habitat downstream of S-332 and S-332D will also be adversely modified through increased hydroperiods due to pumping at those structures that will cause a shift from Muhly dominated to sawgrass dominated habitat. Over time, this habitat alteration will effectively eliminate the available nesting substrate in these areas causing an appreciable reduction in reproductive capability, numbers of birds, and distribution across the eastern portion of the sparrow's range. The condition of critical habitat in the area of subpopulations D and E are anticipated to improve slightly. Due to its location, critical habitat located in the area of subpopulation B would not be affected and no critical habitat is designated in the area of subpopulation A.

In summary, regulatory water releases through the S-12 spillways provide too much water to the western side of Shark River Slough, flooding available nesting habitat during the nesting season, causing declines in the western sparrow subpopulation. Current (Test 7, Phase I) and proposed (Test 7, Phase II) managed water releases also provide insufficient flows to the eastern side of Shark River Slough that create drier habitat conditions, unsuitable nesting substrate, and recurrent fires which preclude successful reproduction. Additionally, flood control operations near the headwaters of Taylor Slough overdrain the northeastern areas facilitating an adverse alteration in vegetative composition and increased fire frequency, while concurrently providing too much dry season water to part of the southern downstream areas. The results are reduced nesting opportunities and a decline in reproductive effort causing declines in eastern sparrow subpopulations. Simulation modeling conducted by Pimm (1997) predicts that without changes in current water management practices, the Cape Sable seaside sparrow will become extinct within two decades.

Snail Kite

The latest snail kite research (Bennetts and Kitchens 1997) suggests that maintaining deep, impounded pools, like those seen in southern WCA 3A under current conditions, will result in degradation of snail kite nesting habitat due to the loss of woody vegetation and degradation of foraging habitat due to the loss of wet prairie communities. The **Experimental Program,** Test 7, Phase I and Phase II, will continue to degrade habitats used by snail kites (Van Lent et al. 1999). This loss of nesting substrate and foraging habitat will adversely effect snail kites by reducing the reproductive potential of snail kite individuals using this area. Although this habitat degradation will occur within designated critical habitat, impacts will not reach the level of adverse modification of critical habitat because only a small percentage of available habitat will be impacted, and snail kite populations will not be appreciably reduced.

Wood Stork

Ogden (1998) defines a set of measures that can be used to evaluate the effects of alternative water management scenarios on the timing of wood stork colony formation. These measures are the duration and timing of hydroperiods in two areas of Shark River Slough known as indicator regions 10 and 11 and the volume and timing of water passing through the southern portions of Shark River Slough and Taylor Slough. Each of these measures provides information on the amount and timing of freshwater reaching the mangrove zone nesting habitat, which, in turn, provides information on when conditions conducive to wood stork colony formation would be expected under various water management scenarios.

The proposed action and the environmental baseline were modeled using the South Florida Water Management Model (SFWMM), and the results were used to generate estimates for each of the measures suggested by Ogden (1998). These results are presented in Van Lent et al. (1999). The inference is that Test 7 produced an overall decline of approximately 13 percent in hydroperiod and flow volume factors related to timing of wood stork colony formation as compared to the environmental baseline. This is a significant decrease in hydroperiod and flow volume which likely would cause wood storks to delay the timing of colony formation (Ogden 1998, personal communication). The adverse effect of delaying colony formation on wood storks is a reduction in reproductive potential due to a reduced period of suitable nesting conditions and an increased probability of nesting failure.

B. Construction Effects

Test 7, Phase II, includes construction activities that would involve the use of heavy earth-moving and other equipment. Information on the exact nature, timing and duration of construction activities is not yet available. Therefore, impacts from these activities will be assumed to be similar to those of other construction activities.

Cape Sable seaside sparrow

Based on the proximity of proposed construction activity at the L-31W berm site and the Aerojet Canal plug site to known Cape Sable seaside sparrow breeding habitat, the Service believes that Cape Sable seaside sparrow individuals could be adversely affected by physical disturbance and/or noise disturbance resulting from these construction activities if they occur during the breeding season and sparrows are actively engaged in breeding activities nearby. This disturbance could include direct crushing of nests by heavy equipment operating in sparrow habitat adjacent to levees, and could cause nesting sparrows to flush from their nests, increasing the likelihood that eggs or nestlings would be lost to predation. Adult sparrows flushed in this manner would experience reduced nesting success due to this disruption of their essential breeding behavior. However, the Corps has agreed to implement a Construction Monitoring Plan for Cape Sable seaside sparrows during proposed construction activities that would minimize disruption to sparrow breeding activities. Because all of the proposed construction activities would occur within the footprints of existing structures, there would be no effect on designated Cape Sable seaside sparrow critical habitat.

Snail Kite, Wood Stork and American Crocodile

The proposed construction sites do not occur within the breeding habitat of the snail kite, wood stork or American crocodile, therefore, breeding activity would not be affected. Any disturbance to foraging activities of snail kites or wood storks, which may sometimes forage near the proposed construction sites, are anticipated to result in insignificant effects. Because all of the proposed construction activities would occur within the footprints of existing structures, there would be no effect to snail kite or American crocodile designated critical habitat.

Modified Water Deliveries

The **Modified Water Deliveries** project consists of major structural modification of, and additions to, the existing system of water control features in the central and southern Everglades that are meant to restore more natural timing, volume and placement of water flows through the action area. In general, the **Modified Water Deliveries** project provides water conveyance and control that allows routing of water that currently passes through WCA 3A into western Shark River Slough, instead passing the water from WCA 3A to WCA 3B and then to Northeast Shark River Slough. The **Modified Water Deliveries** project is likely to adversely effect the snail kite, wood stork, and American crocodile.

A. Hydrological Effects

Snail Kite

The latest snail kite research (Bennetts and Kitchens 1997) suggests that maintaining deep, impounded pools, like those seen in southern WCA 3A under current conditions, will result in degradation of snail kite nesting habitat due to the loss of woody vegetation and degradation of foraging habitat due to the loss of wet prairie communities. The **Modified Water Deliveries** project will continue to degrade habitats used by snail kites (Van Lent et al. 1999). So, habitat degradation similar to that expected under current conditions will likely occur as a result of the **Modified Water Deliveries** project. This loss of nesting substrate and foraging habitat will adversely affect snail kites by reducing the reproductive potential of snail kite individuals using this area.

Impacts to designated critical habitat will not rise to the level of adverse modification because the affected area (southern WCA-3A) represents only a small fraction of available habitat.

Wood Stork

Ogden (1998) defines a set of measures that can be used to evaluate the effects of alternative water management scenarios on the timing of wood stork colony formation. These measures are the duration and timing of hydroperiods in two areas of Shark River Slough known as indicator regions 10 and 11, and the volume and timing of water passing through the southern portions of Shark River Slough and Taylor slough. Each of these measures provides information on the amount and timing of freshwater reaching the mangrove zone nesting habitat, which, in turn, provides information on when conditions conducive to wood stork colony formation would be expected under various water management scenarios.

Van Lent et al. (1999) conclude that implementation of the **Modified Water Deliveries** project would provide a 15 percent decrease in Ogden's (1998) performance measures for Shark River Slough and a 36 percent decrease for Taylor Slough as compared to current conditions. These decreases are of sufficient magnitude to delay the timing of wood stork colony formation (Ogden 1998, personal communication). The adverse effect of delaying colony formation on wood storks is a reduction in reproductive potential due to a reduced period of suitable nesting conditions and an increased probability of nesting failure.

American Crocodile

Adult American crocodiles avoid high salinity habitats and hatchling crocodiles experience decreased growth rates and increased predation when low salinity nursery habitats are not available (Mazzotti and Brandt 1995, U.S. Fish and Wildlife Service 1998). Therefore, an evaluation of any changes in salinities in American crocodile habitats is important in assessing the effects the **Modified Water Deliveries** project will have on American crocodiles.

Van Lent et al. (1999) conclude that expected flow volumes entering Shark River Slough estuaries under **Modified Water Deliveries** conditions are very similar to those occurring under current conditions (represented by Test 7, Phase I). This suggests that American crocodile habitat conditions in this area will not change as a result of the **Modified Water Deliveries** project. However, during certain periods of the year expected flow volumes entering Florida Bay estuaries under **Modified Water Deliveries** conditions would be much lower, particularly from July through November (Van Lent et al. 1999). This would result in substantially higher salinities in Florida Bay estuarine areas during these months. The adverse effects of higher July through November salinities on American crocodiles would be: 1) an increase in predation rates for American crocodile hatchlings due to a reduction in habitable areas that provide adequate cover from predators; and 2) a reduction in survival rates for American crocodile hatchlings due to reduced growth rates that lead to a longer period in which the hatchlings remain in a size class subject to high predation rates. In addition, the Service anticipates that increased salinity levels will not adversely modify designated critical habitat because the affected area represents only a small portion of the species' habitat.

Cape Sable seaside sparrow

The **Modified Water Deliveries** project will provide for water deliveries that mimic more natural water flow conditions across the sparrow's nesting habitat. The Service anticipates these conditions will provide for the frequency of nesting opportunities and maintenance of nesting habitat necessary for the sparrow's long-term viability. Consequently, the Service anticipates the **Modified Water Deliveries** project is not likely to adversely affect the Cape Sable seaside sparrow, nor is it likely to adversely modify designated critical habitat.

B. Construction Effects

The **Modified Water Deliveries** project includes construction activities would involve the use of heavy earth-moving and other equipment. The construction of Pump Stations 355 A and B and raising of Tigertail Camp are ongoing. Information on the exact nature, timing and duration of other construction activities is not yet available. Therefore, impacts from these activities will be assumed to be similar to those of other construction activities.

Snail Kite

Snail kite nests have been reported in the vicinities of the S-349 A, B and C, L-67A and C break, S-355 A and B, and Tigertail Camp sites (Bennetts *et al.* 1994, Bennetts and Kitchens 1997). Based on the close proximity of proposed construction activity at these sites to known snail kite nesting habitat, and observed responses to similar construction activities, the Service believes that snail kite individuals could be adversely affected by physical disturbance resulting from these construction activities if they occur during the breeding season and snail kites are actively engaged in breeding activities nearby. Such harassment could cause nesting snail kites to flush from or abandon their nests, increasing the likelihood that eggs or nestlings would be lost to predators or the elements. This disturbance would also reduce the reproductive potential of adult kites flushed from nests through significant disruption of essential breeding behavior. However, the Corps has agreed to implement a Construction Monitoring Plan for snail kites during proposed construction activities that would minimize disruption to snail kite breeding activities to the point that only insignificant effects are anticipated. Because all of the proposed construction activities would occur within or nearly within the footprints of existing structures, there would be no effect on designated snail kite critical habitat.

Wood Stork

Wood stork nests have been reported in the vicinities of the S-349 A, B and C, L-67A and C break, S-355 A and B, and Tigertail Camp sites (Ogden 1994). Based on the close proximity of proposed construction activity at these sites to known wood stork nesting habitat, the Service believes that wood stork individuals could be adversely affected by physical disturbance and/or noise disturbance resulting from these construction activities if they occur during the breeding season and wood storks are actively engaged in breeding activities nearby. Such harassment could cause nesting storks to be flushed from or abandon their nests, increasing the likelihood that eggs or nestlings would be lost to predation and/or exposure. This disturbance would also reduce the reproductive potential of adult wood storks flushed from nests through the significant disruption of essential breeding behavior. However, the Corps has agreed to implement a Construction Monitoring Plan for wood storks during proposed construction activities that would minimize disruption to wood stork breeding activities to the point that only insignificant effects are anticipated.

American Crocodile and Cape Sable seaside sparrow

The proposed construction sites do not occur within Cape Sable seaside sparrow or American crocodile habitat, therefore, these species would not be affected.

C-111 Project

The **C-111 Project**, located in southeastern Dade County, Florida, adjacent to the eastern boundary of ENP, was authorized as an addition to the C&SF Project by the Flood Control Act of 1962. The original C&SF Project included construction of the ENP-South Dade Conveyance System to provide a water supply to Dade County as well as ENP. This project included enlarging existing canals and construction of new structures and pump stations. However, it soon became apparent that the artificially-amplified flood events were as destructive as the artificial droughts. Congress authorized the **C-111 Project** to correct these problems and provide for more beneficial flow of water to ENP. The **C-111 Project** is likely to benefit listed species in the area overall. However, construction is likely to produce some adverse effects to the Cape Sable seaside sparrow.

A. Hydrological Effects

Specific operational criteria for individual structural features included in the **C-111 Project** have been developed for only one component - the S-332D pump. Hydrological effects resulting from these operations are discussed above as part of the **Experimental Program**. Specific hydrological effects resulting from specific operational criteria of other project features will be analyzed through reinitiation of this section 7 consultation when sufficient information on possible operational criteria and their hydrological effects is available. Information on the other components of C-111 have not yet been developed. A general analysis of hydrological effects is provided below.

Cape Sable seaside sparrow

The **C-111 Project** would increase wet season water flows to the Rocky Glades and Taylor Slough areas, improving hydroperiods in marl prairie habitats in this area, which should maintain suitable nesting substrate and enhance nesting opportunities. Thus, the hydrological effects of the **C-111 Project** are not likely to adversely affect the Cape Sable seaside sparrow, nor is it likely to adversely modify designated critical habitat.

Snail Kite

No known snail kite nesting habitat occurs in areas affected by the **C-111 Project** (Bennetts *et al.* 1994, Bennetts and Kitchens 1997). Therefore, the **C-111 Project** will not adversely affect the snail kite or its designated critical habitat.

Wood Stork

The **C-111 Project** would increase wet season water flows to the Rocky Glades and Taylor Slough areas, improving hydroperiods in marl prairie habitats in this area, and improving the timing and volume of freshwater flows to Florida Bay estuaries (NPS 1993). This should improve availability and timing of food resources important to nesting wood storks (Ogden 1994, U.S. Fish and Wildlife Service 1998). Consequently, implementation of the **C-111 Project** is not likely to adversely affect the wood stork.

American Crocodile

The **C-111 Project** would improve the timing and volume of freshwater flows to Florida Bay estuaries (NPS 1993). Changes in the hydrologic flow that mimic natural flow conditions are likely to benefit crocodiles. Consequently, implementation of the **C-111 Project** is not likely to adversely affect the American crocodile or adversely modify its critical habitat.

B. Construction Effects

The **C-111 Project** includes construction activities involving the use of heavy earth-moving and other equipment. The construction of Pump Station S-332D and Taylor Slough bridge replacement are ongoing. Information on the exact nature, timing and duration of other construction activities is not yet available. Therefore, impacts from these activities will be assumed to be similar to those of other construction activities.

Cape Sable Seaside Sparrow

The L-31 tieback, S-332B, S-332E, Taylor Slough bridge sites and part of the **C-111 Project** spoil mound site are directly adjacent to known Cape Sable seaside sparrow breeding habitat (Figure 3). Due to the proximity of proposed construction activity to these habitats, the Service believes that Cape Sable seaside sparrow individuals could be adversely affected by physical disturbance and/or noise disturbance resulting from these construction activities if they occur during the breeding season and sparrows are actively engaged in breeding activities nearby. Such harassment could cause nesting sparrows to be flushed from their nests, increasing the likelihood that unattended eggs or nestlings could be lost to predation. This disturbance would